

FIREFLIES AND GLOW-WORMS AND THEIR LIGHT.

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There is perhaps no more striking phenomenon in the insect world, than the brilliant and frequently flashing lights exhibited at night by the insects popularly known as Fireflies and Glow-worms, yet at first sight it is astonishing how little is known to scientists at home of the habits of these insects, and of the part played by this luminosity in their life history. But when we consider that our knowledge of these creatures is almost entirely based on the dried specimens of our collections, which are practically never accompanied by detailed or in any way critical notes on their habits as observed by the collectors, this deficiency in our information on the subject becomes more readily intelligible.

The lack of co-operation between the systematic student at home and the actual collector in the field, whether a trained entomologist or not, was particularly brought home to me in conversation on this subject with my friend Mr. K. G. Gairdner on the occasion of his present visit to this country, and it is at his request that these notes are written with the express purpose of interesting the members of the Natural History Society of Siam in the study of these fascinating creatures, and of helping to elucidate the life histories of some of the Siamese species.

With few exceptions, luminous insects throughout the world belong, broadly speaking, to one family of Beetles, the *Lampyridae*, or to give them their popular name, the Fireflies and Glow-worms. The most important exception to this statement is afforded by the Fireflies of the West Indies and Central America, locally known as "Cucujos," which, though still Beetles, belong to quite a different family, the *Elateridae* or Skipjacks.

With the *Lampyridae* are associated a few, small, closely allied families at present very insufficiently known and imperfectly characterised, but which from our point of view are of peculiar interest, since it is to this systematically doubtful position that some of the Siamese species belong.

In the *Lampyridae*, the luminous organs are situated in the terminal or subterminal segments of the abdomen, and the light is shown from the under surface. In dead as well as in living specimens, these luminous areas are usually evident by their whitish, opaque, almost waxy appearance, in strong contrast with the generally dark colour of the underside. Though usually present to a greater or lesser degree in both sexes, the luminous property is generally developed much more highly in one sex than in the other. When it is the male beetle that possesses it in the greater degree, the light is shown when the insect is on the wing, and is generally of an intermittent or flashing character, and gives to the insects their popular name of Fireflies.

On the other hand, when the power of luminosity is the more highly developed in the female beetle, the character is usually associated with a more or less complete absence of wings, and the insect becomes merely a crawling, unpleasant-looking, worm-like creature, generally known in fact as a Glow-worm, which nobody who is not an entomologist would ever dream of calling a Beetle. The males of these insects are winged, in form closely resembling the Fireflies, and are totally unlike their spouses. The consequence of this utter dissimilarity between the two sexes of one species is, that it is not easy to co-relate them properly in our collections. Very often we have large numbers of the males of a species, even of whole groups of species or genera, and yet not a single female that we can say definitely belongs to this species or to that. On the other hand we have a considerable number of females of many different species which we are unable at present to assign to their respective males. Some females, for example, that Mr. Gairdner brought home are of great interest as being differently constructed from females of normal *Lampyridae*: evidently they belong to one of the small closely allied families referred to above, but to which species or even genus they should be assigned cannot be determined without a knowledge of the male. We have also in the British Museum collection some larvae from Siam,

also undetermined, which belong apparently to the same species, hence it is very desirable that the male be ascertained and the identity of the species established.

In this case the requisite information may be obtained in various ways, either by rearing the larva and breeding the male beetles from them, or by catching the male beetle when it comes to pair with the living female and forwarding both insects for identification.* Both these methods may require a little patience, but in neither case are the difficulties likely to be insuperable.

As regards the first method, the first step is to be able to distinguish the larva from the perfect female, for the resemblance between the two is very close.

The most ready means of distinction lies perhaps in the legs; in the larva these are short and pointed, almost conical, terminating in a single stout claw, while in the female beetle they are rather longer and more slender, the different sections being articulated at an angle, and the last section, the foot or tarsus, being composed of five (or perhaps only four or three) minute joints, the last of which terminates in two slender claws.

If the specimen found prove to be a larva, it should feed, judging from the analogy of the better known species of this group, on small snails and slugs, and if kept moist with a plentiful supply of food, should complete its transformations without much trouble. A small tin box with a tightly fitting lid, half filled with fine earth, makes a convenient breeding cage, and is easily cleaned and kept free from mould. When full grown the larva will remain quiescent for a few days, lying on its side and taking no food; it will then cast its skin and become a pupa; this is at first white, but gradually becomes darker, the change showing most quickly and most completely in the eyes. If the pupa is to produce a male beetle, the rudiments of wings will now be visible at the sides of the body, but if it is to produce a female beetle there will be hardly any noticeable change from the form of the larva, except in the limbs which now are fixed and motionless. A few days in this state should be sufficient, then the pupa will in turn cast its skin and the perfect beetle emerge.

* In the case of specimens captured *in cop.* particular care should be taken that the pairs are kept together and confusion with other specimens avoided.

If the female beetle has been secured, she should be kept alive and placed in a likely situation, and a watch kept for the males coming to visit her. At the same time it is essential that careful notes should be made of the behaviour of the female and of the arrival of the male. As an indication of what may be expected a brief account of the habits of some of our better known species may not be out of place.

Many members of the Natural History Society of Siam will no doubt be familiar with the common Glow-worm of our English lanes and hedges. The pale greenish lights may sometimes be observed in numbers in the grass by the roadside in June and July. At Lugano this summer they were noticed to be particularly partial to the walls, sitting sometimes 10 or 12 feet from the ground, and in this situation their light would be visible from a long distance. If more closely observed, whether sitting on the ground amongst low vegetation, or hanging vertically on some stem a few inches above it, the light will be seen streaming from the organ on the underside of the tail; the body is twisted first to one side then to the other, in order to expose the light more fully. Often I have carefully noted the position of one of these lights and visited the spot from time to time; at one visit the light has been found to have disappeared, but a careful search of the spot where it should be, has revealed the female beetle with one or more males in close attendance. Unfortunately I have never been able to witness the actual arrival of the male, which in this species is not or but very feebly luminous.

Mr. E. G. Green (1) has published notes on the use of the light of two species of Glow-worm from Ceylon. In one of these, *Lamprophorus tenebrosus*, the apterous female exhibits her light much as does our Glow-worm; the male, though normally brilliant, approaches a "calling" female with the light shut off, its advent being heralded only by the partial extinction of the light of the female. In the other, *Dioptrina adamsi*, the larviform female was observed to recurve the body over the back so as to exhibit the ventral subterminal light organ. On the approach of the male, the light was partially eclipsed and the tail turned down. The male at the time was not known to be luminous, but under the stimulus of sexual excitement it was observed to exhibit luminous spots along the sides of the abdomen

(1) *Trans. Ent. Soc.* 1912, p. 717.

and on the thorax. This is an unusual type of illumination for the *Lampyridae*, but the genus *Diopptoma* is one of those of rather doubtful systematic position to which reference has been made above. To this genus may possibly belong the undetermined Siamese female mentioned earlier, which, Mr. Gairdner informs me, behaved in a very similar manner.

The Fireflies of Southern Europe have been critically observed by Emery (2) and others, and only this summer my friend Mr. Hugh Main and I spent several evenings at Lugano watching the behaviour of *Luciola italicica*. In this species and its allies, both sexes are winged, but all the specimens caught on the wing are found to be males. The females closely resemble them, but are rather smaller and less parallel, with the eyes very much smaller in proportion. They are of a more sluggish disposition, and are found lurking in the grass and low herbage. Very soon after sunset the lights of the flying males may be observed sparkling over the grass; as it becomes darker a careful search will probably detect the fainter more continuous light of the female close to the ground. If one of these be kept under observation, the light will be found to disappear at intervals, then to shine again, sometimes continuously, sometimes with a flashing periodicity much slower than that of the male. While the light is shining, a passing male perceiving it will alter his course and fly down, alighting near the female; he then approaches flashing vigorously, as if not quite sure of her exact whereabouts, until he finds her, when the lights of both are extinguished. Even when one male is in attendance the female may start flashing again to attract another, and it is not uncommon to find a small group of males gathered round one female. Though often observed quite early in the evening we frequently noticed that the lights of the females were more numerous and brighter about 10 or 11 p.m. when the lights of the males were becoming scarcer, as though the females, despairing of attracting a mate, were becoming bolder in their efforts. In this species as observed by us, there was no suggestion of the synchronous flashing in concert of large numbers of males that is recorded of another European species as well as of numerous tropical species both of the Old and New Worlds, and which is mentioned by Mr. Gairdner as being very striking in the case of certain Siamese species.

(2) *Bull. Soc. Ent. Ital.* 1886. p. 406.

Of late years much important work has been done by Mr. A. McDermott (3) upon North American species of Fireflies. These insects, popularly known as Lightning-bugs, resemble the Fireflies of Southern Europe mentioned above in that the male beetle flies about flashing his light, while the female lurks in the grass below. But whereas in the case for example of the European *L. italica* the female would seem to shew her light on her own initiative to attract the attention of passing males, in the American Lightning-bugs (and also in the European species observed by Emery) the female is more modest, and shews her light only in reply to the "calling" flash of the male. In the United States the number of species is very considerable, and in many cases two or more of them have been found flying together over the same ground, so that specific differences in the light exhibited have been evolved to a high degree. A female of one species will, as a rule, only reply to the flash of a male of her own species, and a searching male will only respond to the answering flash of a female of his own species. Specific differences are found to exist in the periodicity of the flash, in its colour, its duration or in its direction, some species rising and falling with a kind of dancing motion and omitting the flash on the dip or on the rise, etc. Mr. McDermott's investigations were assisted by an ingenious series of experiments with small electric bulbs, which could be operated to simulate the flash of the particular species under observation. A brief summary of some of his results may serve as a guide to similar enquires in other parts of the world.

Photinus pyralis. The flash of the female is given 3 or 4 seconds after that of the male, and is of the same colour but of longer duration and less intense.

Females would answer in numbers to the flash of a match swung in an arc to simulate the flash of a male, though as a rule not more than one female would reply to a flashing male.

A particular female would not reply to the flash of a male of another species (*P. consanguineus*) though she would to that of a match.

The male could also be deceived by a bulb placed in the grass and flashed 3 or 5 seconds after his own flash. When the bulb was flashed without the pause it was not so effective.

No male was observed to reply to the flash of a creeping male.

P. consanguineus. The male gives a double flash in quick succession followed by a pause, then another flash, and so on; the female replies within a second to the second flash of the male. A particular female would not reply to the flash of a match, but would answer the double flash of a bulb when 20 or 30 feet away; on a nearer approach she seemed to recognise something unusual and would not reply.

P. scintillans. The male gives a short single flash, and the female a longer single flash.

A female would reply to the first flash of a male of *P. consanguineus* but the latter takes no notice. The female of this species is apterous.

P. marginellus. The male gives a single short sharp flash yellower than that of *P. scintillans*: the female replies with a double flash, the first sharper and brighter than the second and followed at once by the second. The reply is given very quickly after the flash of the male.

P. castus. The male gives a single flash not so short and sudden as that of *P. marginellus*; the female gives a single flash very much like that of *P. scintillans* but delivered immediately after the flash of the male; there is no distinct pause as in *P. pyralis* and no indication of doubling as in *P. marginellus*. These last two species are very similar, and indeed by some authorities they have been considered to be merely forms of the same. Mr McDermott admits that he can find no structural difference between them, but their flash is so distinct that he considers them good species. They are frequently found flying together but no case of interbreeding has been observed though specially watched for.

Careful observations of this nature, not only upon Fireflies but upon insects of any sort are very badly wanted. Too often such habits are regarded as merely everyday events of no particular interest, yet outside the particular region in which the species occur very little is known about them. At the same time it is very necessary that the species of which such habits are recorded should be correctly determined; notes on the habits of any animal only vaguely or loosely specified are of little use, hence it is essential, if any observations are to be of scientific value, that specimens should be collected and their identity definitely estab-

shed. It is to be hoped that before long the Society will have its own reference collection of the Siamese fauna, which will greatly facilitate such identifications, but until then specimens may be forwarded for comparison to the National Collection at the Natural History Museum, South Kensington. If at any time I can render any assistance, either in making the necessary comparisons or in other ways, I shall be most happy to place my services at the disposal of the Society, and any material or notes concerning the subject of this paper will be most welcome.
